Using the Meta-Environment for Model-Driven Engineering

Tijs van der Storm, Ph.D.
Centrum voor Wiskunde en Informatica
storm@cwi.nl
http://homepages.cwi.nl/~storm

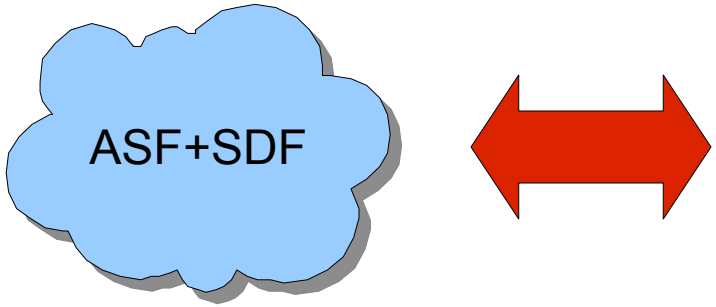
Introduction

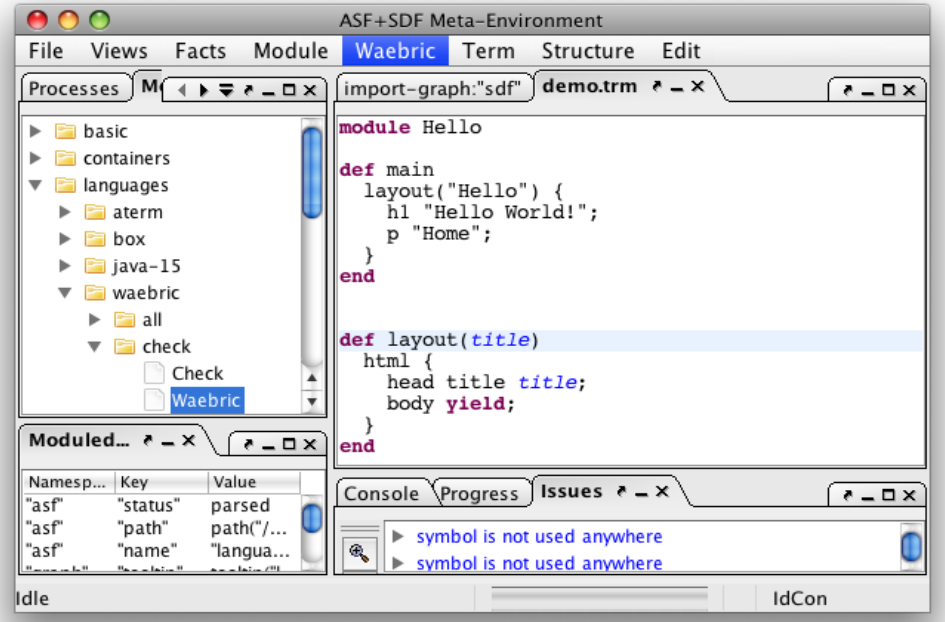
- Me: Tijs van der Storm
- Researcher (CWI) / teacher (UvA)
- Interests:
  - Software evolution
  - Programming languages
- Today:
  - *Using the Meta-Environment...*
  - *for Model Driven Engineering (MDE)*

The Meta-Environment

a programming environment for languages

ASF+SDF Meta-Environment





ASF: Algebraic Specification Formalism
SDF: Syntax Definition Formalism

Introducing the Meta-Environment

...in counterpoint with Smalltalk

Smalltalk

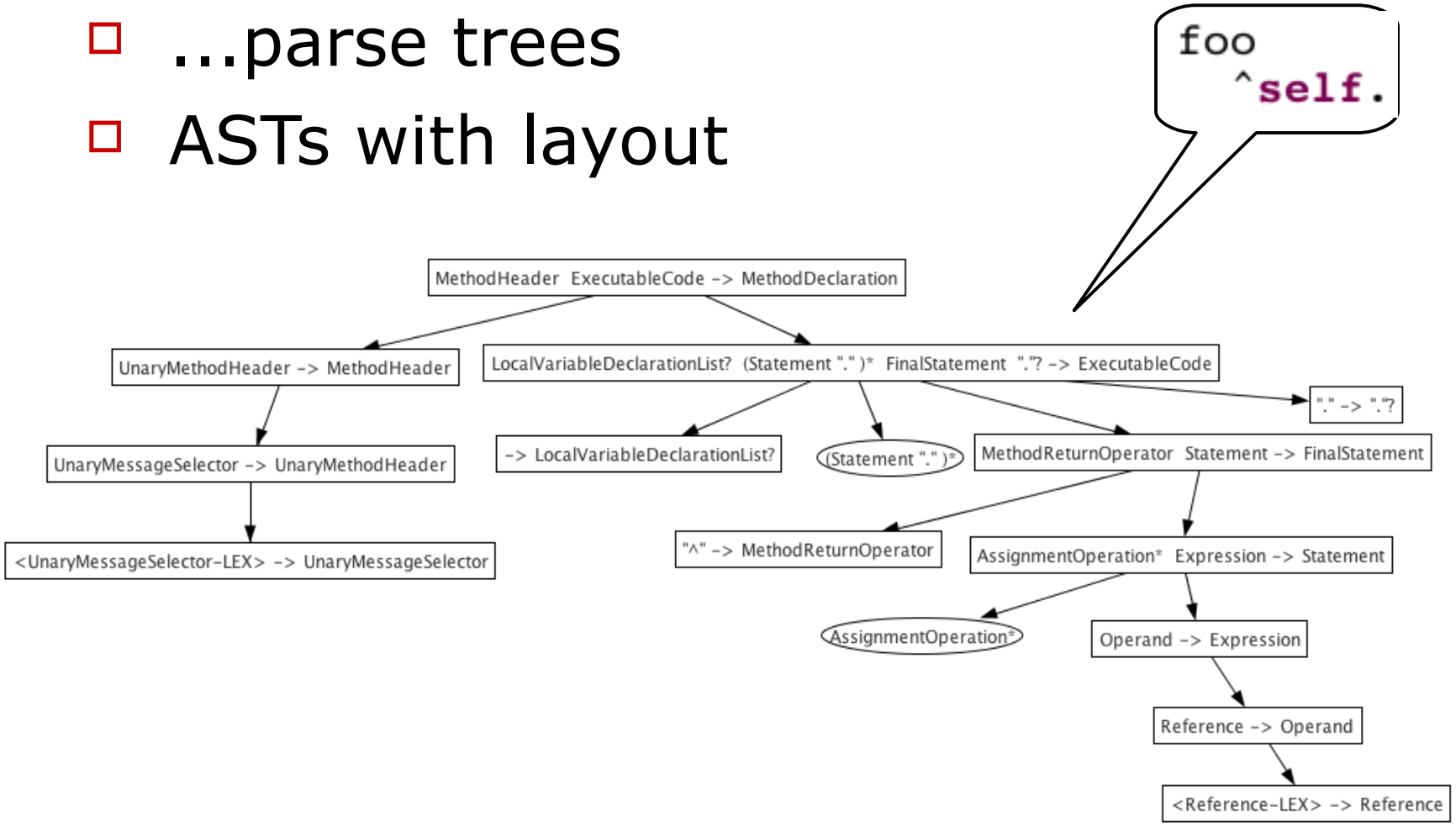
Everything is an object

ASF+SDF Meta-Environment

Everything is (parsed) “source code”
(also called “terms”)

Terms are trees

- ...parse trees
- ASTs with layout



Smalltalk

Every object has a class

ASF+SDF Meta-Environment

All source code has syntax
(defined by context-free grammars)

SDF: Syntax Definition Formalism

- Similar to EBNF
- Modular
- Arbitrary CFGs
- GLR parsing
- Scannerless
- Disambiguation

```
context-free syntax
  UnaryMessageSelector                          -> UnaryMethodHeader
  BinaryMessageSelector BindableIdentifier      -> BinaryMethodHeader
  Keyword BindableIdentifier                    -> KeywordMethodHeaderSegment
  KeywordMethodHeaderSegment+                   -> KeywordMethodHeader
  UnaryMethodHeader                             -> MethodHeader
  BinaryMethodHeader                            -> MethodHeader
  KeywordMethodHeader                           -> MethodHeader
  MethodHeader ExecutableCode                   -> MethodDeclaration
```

Smalltalk

All computation occurs through messages

ASF+SDF Meta-Environment

All computation is transformation
(described using rewrite rules)

ASF: Algebraic Specification Formalism

- Concrete syntax
  - Match
  - Construct
- Term rewriting
- Purely functional
- Automatic traversal
  - traversal functions

```
x + 0 = x
x * 1 = x
x * (y + z) =
  x * y + x * z

if !x then S1 else S2 =
  if x then S2 else S1

compile(while x do S) =
    LOOP:
       load x;
       jz END;
       compile(S);
       jmp LOOP;
    END:
```

Smalltalk

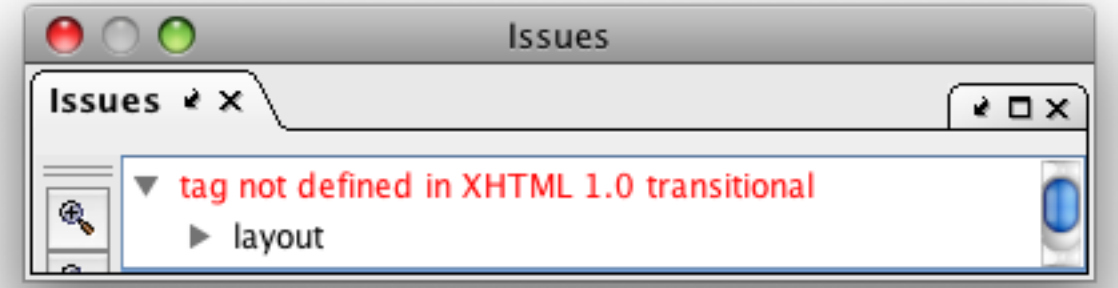
The language = the environment

ASF+SDF Meta-Environment

Languages are environment contracts
(environment knows about some languages)

Integration in the environment

- Little languages
  - Errors
  - Facts
  - Formatting
  - ...
- Easily extended
  - Define a language
  - + GUI plugin



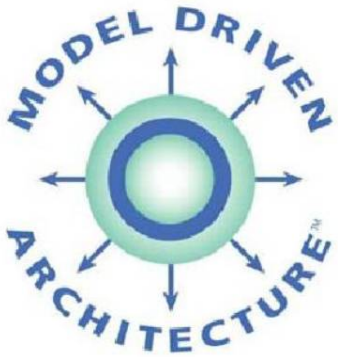
ASF+SDF Meta-Environment

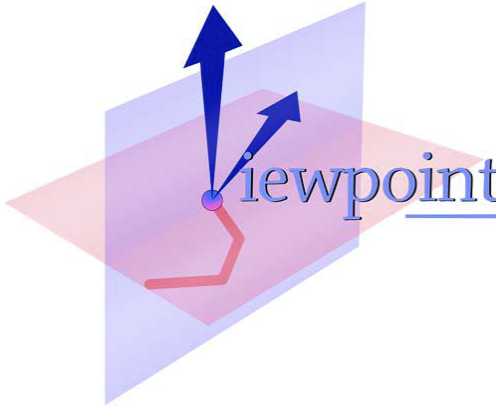
What does it have to do with MDE?

What is MDE anyway?

Magritte

Fame





Viewpoints Research Institute

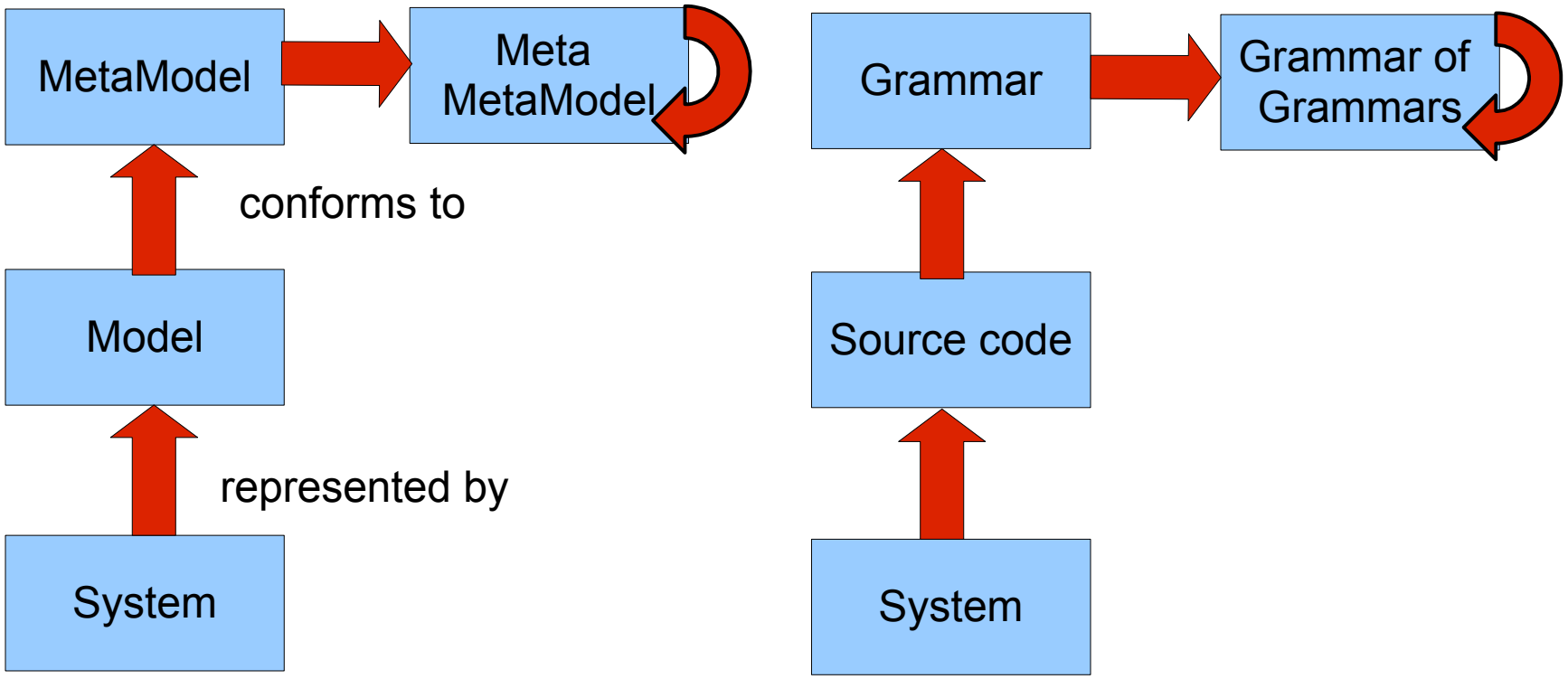
OMeta

MBA Smalltalk

Model driven engineering

- Domain specific notations
  - graphical
  - textual
- Transformation
  - code generation
  - model-to-model
  - “compilation”

MDE & the Meta-Environment



Adapted from: Jean Bézivin, *On the Unification Power of Models,* UML 2003

A little language for Markup

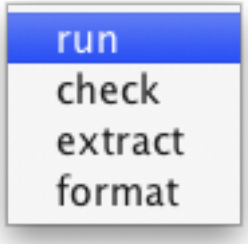
seaside

programmatic HTML

A simple example

```
def main
  layout("Hello") {
    h1 "Hello World!";
    p "Home";
  }
end

def layout(title)
  html {
    head title title;
    body yield;
  }
end
```



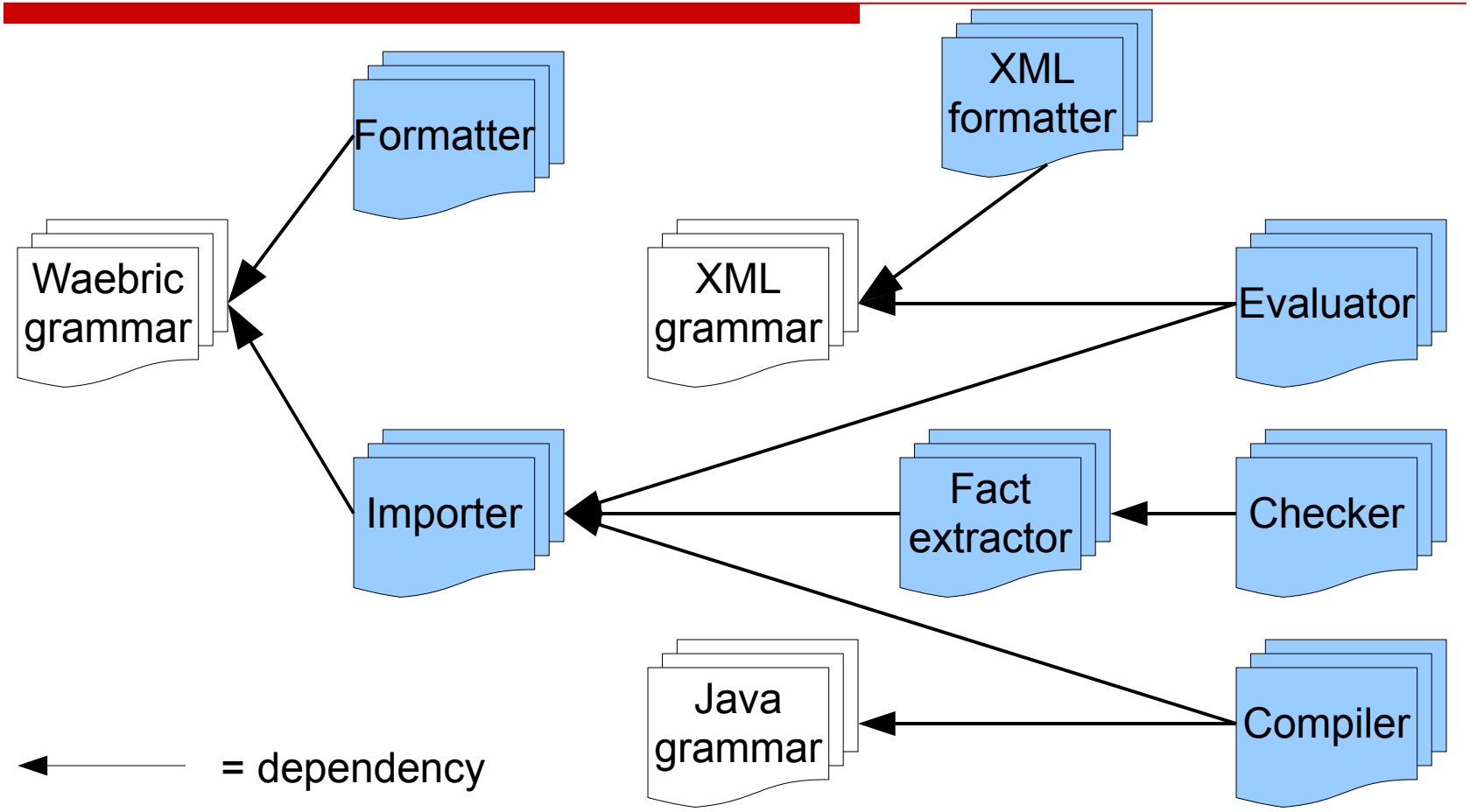

```
<html>
  <head>
    <title>
      Hello
    </title>
  </head>
  <body>
    <h1>
      Hello World!
    </h1>
    <p>
      Home
    </p>
  </body>
</html>
```

Recursive menus

```
def menu(menu)
  echo menu.title;
  ul {
    each (kid: menu.kids)
      item(kid);
  }
end

def item(mi)
  if (mi.kids)
    li menu(mi);
  else
    li a(href=mi.link) mi.title;
end
```

Waebric tool architecture



Demo

Results: Source Lines of Code

Component	SDF	ASF	Total SLOC
Java grammar	*1583*	*0*	*1583*
XML grammar (w/o DTDs)	*109*	*0*	*109*
Waebric grammar	248	0	248
Evaluator	348	685	1033
Compiler	277	611	888
Import resolver	106	87	193
Checker	131	174	305
Fact extractor	84	119	203
Waebric formatter	129	43	172
XHTML formatter	50	100	150
	3065	1819	4884

Summary

- Meta-Environment
  - All data has syntax
  - All computation is transformation
  - Languages are environment contracts
- MDE = DSL engineering (a.o.)
- Waebric case-study

Thank you!

- Questions?
- More info:
  - http://meta-environment.org
- storm@cwi.nl

to be released soon...

END